The profiles of science and technology culture (STC) indicators

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Abstract. *Culture of science and technology is the way of life of the academic community that includes ways of thinking, understanding and use of technology, beliefs, habits, how to use the language, attitudes, and judgments based on scientific methods and knowledge. Survey of 10 indicators of science and technology culture conducted to 467 high school students in Indonesia and 784 students in Malaysia. Based on 10 indicators, developed an instruments of Likert attitude scale and a multiple choice tests as a basis for indicators of science and technology culture. The survey results showed that students SM Malaysia and Indonesia have the same ability and views about; Knowledge of Science and Technology Basic, Understanding the limitations of human reason, and understanding of science and technology indicators, and the student chooses more amenable Science and Technology activities conducted outside school hours. Overall, the profiles of Science and Technology culture among students SM SM Indonesia Malaysia and there is no significant difference at the 1% significance level (t = 0:04). Based on the interpretation of the scale suggested by Green & Akey, the results of this study showed that the culture of Science and Technology indicators proposed in this study include both categories, namely 0.75 (high) Indonesian and 0.74 (high) Malaysian. Therefore it can be said that Malaysian and Indonesian students have a positive attitude towards Science and Technology. In the context of the Science and Technology Education, the results of this study provide some indicators that can be used as learning objectives in the curriculum of Science and Technology in the Secondary School*
Key words: *culture indicators, science and technology, attitude.*

Introduction

Mastering sciences and technology for welfare and development of human beings is one purpose of developing nation's technology and economic in future (DIKTI, 2005). In this connection, it is really important to know the existence of sciences and technology cultures among students. The most important step in studying the sciences and technology cultures is devising the research instruments for measuring the sciences and technology cultures. Defining the term of sciences and technology cultures operationally with regard to the respective countries is the main factor supporting the development of the measurement instruments of sciences and technology cultures (Subahan 2006).

Research on sciences and technology cultures in Malaysia has been started since 2000 by several research groups, namely Robiah et al (2000), Rusilawati Othman (2007), Subahan & Halim (2008), dan Halim *et al* (2009). Subahan & Halim (2008) succeeded to improve the previous measurement instruments ((Rusilawati Othman 2007) by taking into account the component of recent issues and the component of current images of sciences and scientits from students's perspective. As the results, it has been developed and validated 15 components and 133 items of the instrument for measuring sciences and technology cultures (IPBST) (Halim *et al* 2009). The developed instruments were tested on 784 students at senior high schools in Malaysia and 270 students at senior high schools in Aceh, Indonesia, showing that the Alpha Crombach and corelation indexes are about 0.684 dan 0.283, respectively. Validation process conducted by 7 (seven) experts from National University of Malaysia (UKM), Malaysia and 5 (five) experts from Syiah Kuala University, Aceh, Indonesia shows that, on average, they have endorsed the 15 components and 133 items of the measurement instruments (IPBST). This year, 2010, this research will continue to measure the existence sciences and technology cultures among students from senior high schools (Sekolah Menengah Kerajaan, SMK) in Malaysia and also students from senior high

schools (Sekolah Menengah Atas, SMA) in Indonesia. After having workshop about this research progress on October 2009, it has been determined 1000 senior high school students in Malaysia and 2500 senior high schools in Indonesia as the research's sample on 2010. Using the instruments for measurement of sciences and technology cultures (IPBST), developed in the previous research, Halim *et al* (2009), the research for mapping the existence of sciences and technology cultures will be continued to senior high school students in Malaysia Peninsula and Indonesia (Sumatra dan Java).

Students as one of academic entities and human capital for development nation's technology and economic in future should have positive perspective and attitude toward sciences and technology. The positive perspective and attitude could be formalize well during sciences education learning and teaching procesess using education curriculum based on sciences and technology cultures. In order to develop a perfect science education curriculum for secondary level, data on the existence of sciences and technology cultures among students at senior high schools are really crucial. Therefore, we do hope to obtain these kind of data from this collaborative project on 2010, namely (i) Profile of the science and technology cultures indicator for students in Malaysia and Indonesia, and (ii) Comparison Indonesian student's perspective and the indicator of attitude toward sciences and technology with other countries student's in the world, especially Malaysia.

Research Methodology

Based on objective studies, this research includes 7 (seven) steps which relates one to each others. Four steps, namely the first, the second, the third, and the fourth have been carried out on 2009 (Halim *et al* 2009). While the fifth step will start on 2010 for determining sample and performing the actual research on students at senior high schools.

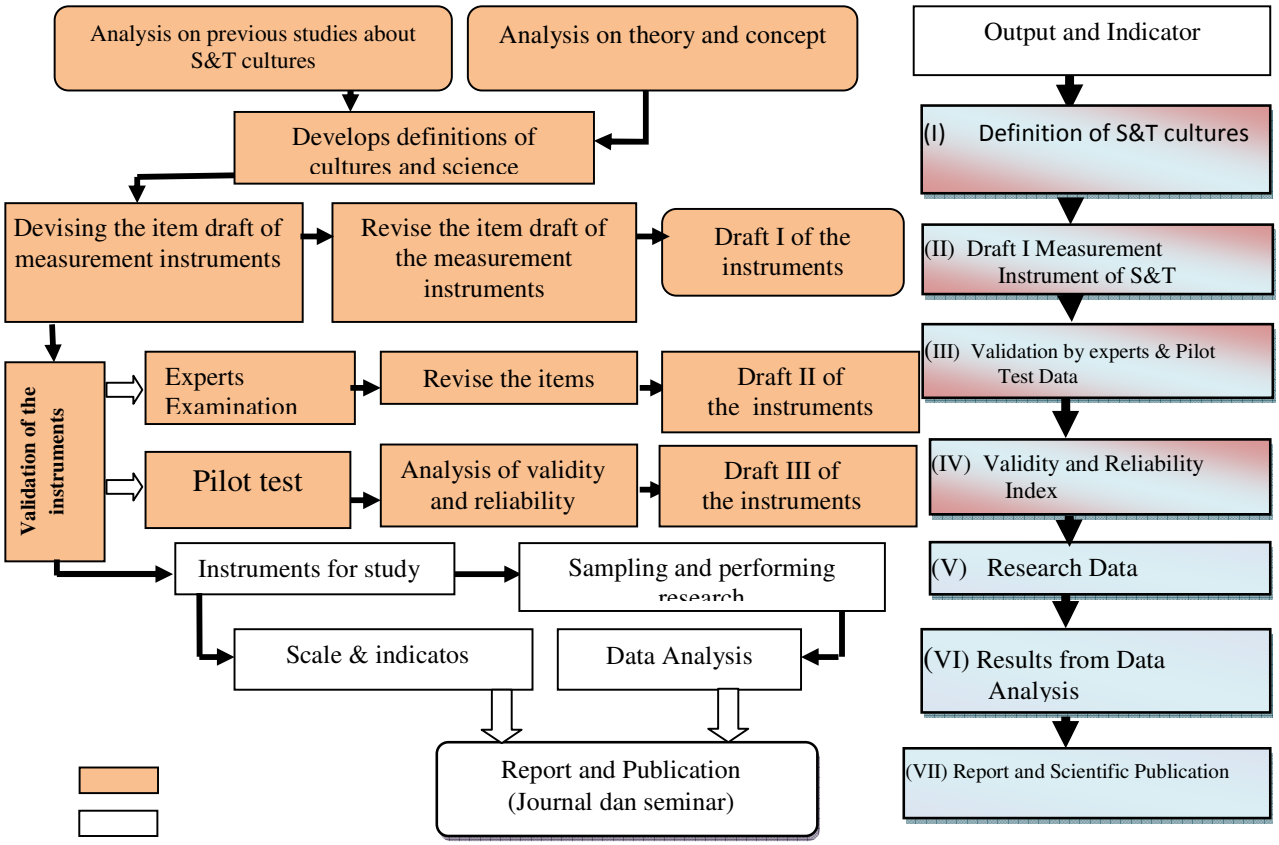

Figure 1. Diagram of the Sistematics of the research methodology

After having workshop about this research progress on October 2009, it has been determined 1000 senior high school students in Malaysia and 2500 senior high schools in Indonesia as the research's sample on 2010. Next step, analyzing research data using descriptive and inferensive statistics (correlation analysis, ANOVA, and MANOVA). In order to obtain the picture of students's anwers for each indicator of the measurement instruments, the answers would be analyzed using RASCH method.

Results and Discussion

The analysis of the main effect of (i) country and (ii) science and technology culture subscales were conducted based on 2 x 13 Multivariate Analysis of Variance (MANOVA) with repeated measures. The main null hypothesis (Ho) is: "There is no significant difference in the science and technology culture subscales mean score between Malaysian and Indonesian students". The test was significant, which implied that there homogenity of variance is not assumed. Nevertheless, the result doesn't affect the analysis of MANOVA since the sample size of both countries did not differ much and the effect size of type 1 error is too small. The multivariate test indicated a significant science and technology culture subscales main effect, Wilks, = 0.142, F(9,1108) = 746,188, p = 0.000, partial η^2 = 0.858; and significant science and technology culture subscales by country interaction effect Wilks' = 0.559, F (9.118) = 97.310, p = 0.000, partial η^2 = 0.441. Observed power for all factors was 1.00.

The main effect of science and technology culture subscales is significant, and thus it can be assumed that the science and technology culture mean scores are influenced by the thirteen subscales of science and technology culture. A significant result was also noted for the science and technology culture subscales (STCs) by country, suggesting that the science and technology culture mean scores were affected by the combined influence of country and STCs. It is suggested that when interaction effect is significant, a follow-up analysis of the interaction should be conducted to confirm the source of effect. Hence, the t-test was conducted to compare each STCs between Indonesian and Malaysian students. Since the analysis was done separately for each STCs, the higher alpha value is set to reduce the chance of Type 1 error (finding a significant result when in fact there isn't really one). Thus, Bonferroni adjustment technique is used by dividing the alpha level of 0.05 by the number of STCs (13 subscales). Therefore, a significant result will be considered if the probability value is 0.005. Table 1 shows the independent-samples t-test for each of the subscales.

Tables 1. Response and profiles of indicators of S&T culture

Indicators	Mean		Standard deviations		t	T	Reject	P
	M(1)	M(2)	Sd(1)	Sd(2)	statistic	tables	Ho	
A	2.120	1.990	0.539	0.443	4.616	2.580	Yes	0.0000
B	1.909	1.667	0.460	0.365	9.700	2.580	Yes	0.0004
C	2.528	2.436	0.457	0.413	3.561	2.580	Yes	0.0000
D	2.538	2.874	0.484	0.573	-11.06	2.580	Yes	0.0000
E	2.739	2.941	0.611	0.662	-5.473	2.580	Yes	0.0000
F	2.107	2.044	0.542	0.425	2.136	2.580	No	0.0330
G	2.266	2.263	0.466	0.445	0.118	2.580	No	0.9060
H	1.874	2.002	0.554	0.453	-4.219	2.580	Yes	0.0000
I	2.478	2.232	0.597	0.528	7.350	2.580	Yes	0.0000
J	1.689	1.655	0.252	0.337	2.073	2.580	No	0.0380
Totality	**2.023**	**2.009**	**0.745**	**0.787**	**0.04**	**2.845**	**No**	**0.968**

Ket: (1): High School in Malaysia; (2): High School in Indonesia.
A : Attitude among Science and Technology
B : Awareness to Environment
F : Understanding the Limitations of Human Mind
G : The View of Students among the Science and

Technology Indicators

C : Characteristics of Science
D : Ethics of Science and Techonology
E : Student Attitudes Toward Use of Experimental Animals
H : Scientific-minded habit of Students
I : Activities outside the School of Science Students
J : Basic knowledge of Students about Science.

Table 1 shows that there the mean scores for Malaysian students in eight of thirteen subscales are significantly higher to that of the Indonesian students. Those subscales are attitude toward S&T, conception of nature of science, scientist behavior, realization of limits of mankind, basic of science knowledge, identify technology sign, science activities out of school, and attitude toward animal experimentation.

The finding related to the Indonesian students shows the curriculum for science and technology is developed by science and technology teachers, using the national content standards as a reference. To be sure that the national content standards are upheld, the Board for National Standards in Education and the Textbooks Evaluation Center coordinates an evaluation of selected textbooks by supervisors, experts, education professors, and experienced teachers. According to the 2006 national content standard of science and technology, students should have been taught each of the following topics or skills by the **end of grade 9.** Careers in science and technology less priorities among the Indonesia society, because difficult to find a job in future. Related to socialization of science and technology on Indonesia society, Indonesian focuses on the practical use of S&T and emphasis on practical use is not always suitable for creating science, which aims at exploring the absolute truth (Ministry of National Education 2005).

It appears that the science and technology culture measured in this study is inclined toward nurturing scientific spirit that aims to explore the absolute truth and hence creating sciencetific knowledge. The impressive development of S&T in Malaysia measured in terms of expenditure on science education, R&D and the number of students graduating in S&T fields (Shah 2004) is a testimony of science and technology culture fostered. Nevertheless, if Indonesia science education system aims to go beyong the basic science and toward innovation, perhaps the adoption of the Malaysian model which focus on the role and benefit of S&T and on adopted S&T culture in terms of attitude and receptiveness is the way forward.

Conclusion and Recomendation

This study sets out to benchmark the indicators of Indonesian secondary students to that Malaysian students in terms of their level of science and technology culture. The sample involved in both countries did not represent respondents from all over the country, but for comperative purposes, it is valid since the sample involved was chosen based on similar students characteristics. The finding show that the performance of the Malaysian students was significantly higher than that of the Indonesian students in most of science and technology culture subscales. The performance of the Malaysian sample could be considered as an achievement since Indonesian is being used as the benchmark to gauge Malaysia's science education in inculcating the science and technology culture.

The Indonesian students scored significantly lower in areas of attitude toward S&T, conception of nature of science, scientist behavior, realization of limits of mankind, basic of science knowledge, identify technology sign, science activities out of school, and attitude toward animal experimentation. This perhaps is not surprising since studies on public attitude toward S&T conducted by Malaysian Science and Technology Information Centre (MASTIC 2004). This indicated Malaysians were positive about the role and benefit of S&T and on the whole Malaysians have already adopted S&T culture in terms of attitude and receptiveness. Futhermore, careers in science, engineering and medical fields are still priorities among the Malaysia society thus participation as well as interest in science

education is high. Even students who are studying in the arts or social science streams need to study science.

The finding of all information and data about the exsistence of science and technology culture among Indonesian high school students need to conducts research in Kalimatan, Sulawesi, and Irian islands as the next year research. For the development of scale and indicators of science and technology culture instrument the research was need to continue on the next year. The other suggestion, research on the exsistence of science and technology culture can also conducted among students of secondary and basic school or among publics society or people as a whole in Malaysia and Indonesia.

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